Puget Sound Traffic Choices Study

Washington State Transportation Commission

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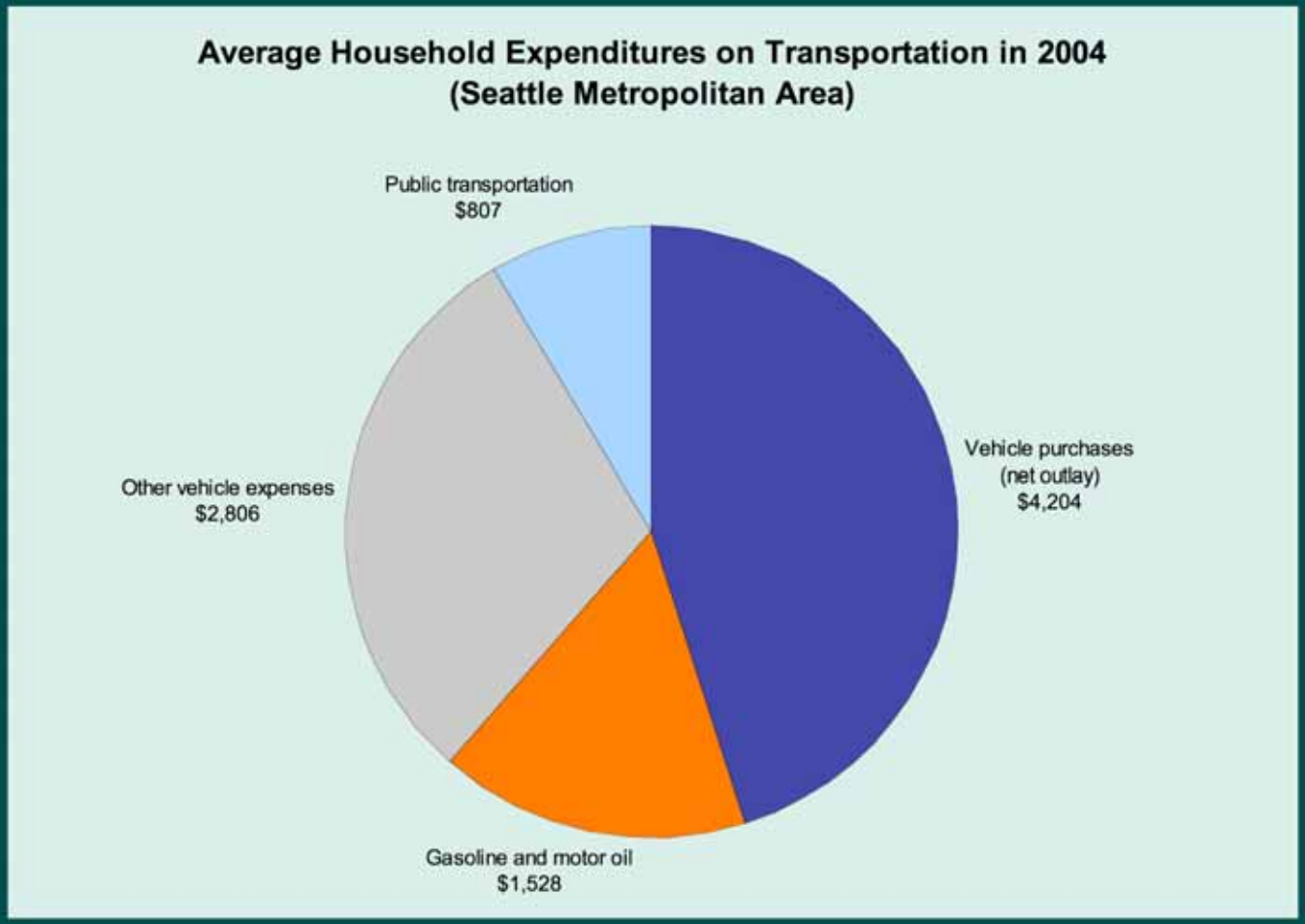
BACKGROUND - Paying for Transportation

Public expenditures are a comparatively small, but critical, portion of the full costs of sustaining our transportation systems

1998 Transportation Price Tag

expenditure	billions $$	% of total
private auto ownership & operation	16.3	62%
freight (moving goods & services)	6.4	24%
bikes, bus & ferry fares, etc.	0.2	1%
roads, transit, ferries & other services provided with the taxes we pay	2.1	8%
congestion/pollution	1.2	5%
total		$26.2 billion

BACKGROUND - Part of the transportation price tag



Sources: 2002 Consumer Expenditure Survey

BACKGROUND – Financing Justification

- **Road Finance System is financially weak**
  - Poor fiscal elasticity of the gas tax, especially with new fuels
  - New capacity costs are rising with urbanization, and maintenance costs are rising as system ages
- **System performance is declining**
  - Congestion, road conditions deteriorating
  - Land use regulation, transit policy not obviating the problem
- **Gas tax (and other tax-based) finance perceived as unfair**
  - Expensive new capacity that benefits targeted taxpayers
  - Requires cross-subsidies, among regions, types of users
  - Hence, public support for general tax increases is ambiguous at best
- **Conventional road finance is a vicious circle**
  - We levy an average charge on all mileage...
  - …creating localized congestion during peak periods
  - The congestion prompts road authorities to build, but the low charges cannot cover the costs!
- **Demand pricing can break the circle**
  - Charges are levied selectively on certain vehicle-miles
  - Controls excessive congestion during peak periods
  - Demand pricing generates the revenue to build capacity when it is really needed, from those who burden capacity

BACKGROUND – Project Origins

- ***Destination 2030* Recommendation**
  - Plan, design and implement a roadway pricing demonstration project prior to 2006.
- **FHWA Value Pricing Program**
  - Awarded $1.88 million in grant funds for the Puget Sound region study in 2002.
  - Supplemental funding of $600,000 in 2005.

OVERVIEW – Traffic Choices Study

Contributions to the Application of Road User Charging:

- **Detailed analysis of road user choice and behavior under a broadly implemented and sustained tolling treatment**
  - Over 400 volunteer participants
  - Tolling on all major roads in the Puget Sound region
  - Tolls based on time of day and type of road
  - Preliminary results show quantifiable change of driving behavior in response to tolls
- **Part of the ongoing development and proofing of technical applications and systems design**
  - In-vehicle GPS-based OBU tolling
  - Communicating to central system via GPRS
  - First large-scale operational test showing the feasibility of area-wide road use and congestion charging
- **A pilot for identifying and understanding key policy variables and requirements**

OVERVIEW - Study Specifics

- **The deployment of a network application of road user charging technology, using a sample of volunteer participants**
  - Siemens ITS off-the-shelf toll system solution
  - GPS vehicle positioning
  - Cellular communication
  - Back Office, billing and customer service functionality
- **The only study designed explicitly to capture behavioral response to network tolls in an experimental setting**
  - True price incentive
  - Baseline and experimental treatments (tolls)
  - Controls for self-selection, attrition, seasonality, etc.
  - Time of day pricing
  - Multiple sources of price information (in-vehicle display, accounts, invoices)

OVERVIEW - Key Findings

- Core technology for satellite-based toll systems is mature
- Observed response of drivers to tolls empirically suggests there is a practical opportunity to reduce wasted time resources and convert them to revenues for investment.
- We must still demonstrate that such a charging system will be technically verifiable and legally enforceable, within bounds of what is politically acceptable.
- A large-scale U.S. deployment of a GPS-based tolling solution depends on a viable business model and public acceptance of underlying concepts

OPERATION - Participant-Centered Project

- 275+ households
- 400+ vehicles
- Randomly selected from an enriched pool of potential participant households
- Each participating household was provided a unique travel endowment account, based on their baseline travel behavior
- Tolls were levied against this endowment account
- At the end of the tolling period participants were provided any remaining account balance

OPERATION - Schedule

System delivery

Acceptance test

Participant recruitment and enrollment

Pre-implementation	2005									2006					
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
	Control			Experimental Treatment - Tolls								Control	Analysis →		

Crossover design - before and after control data

OPERATION - Charges

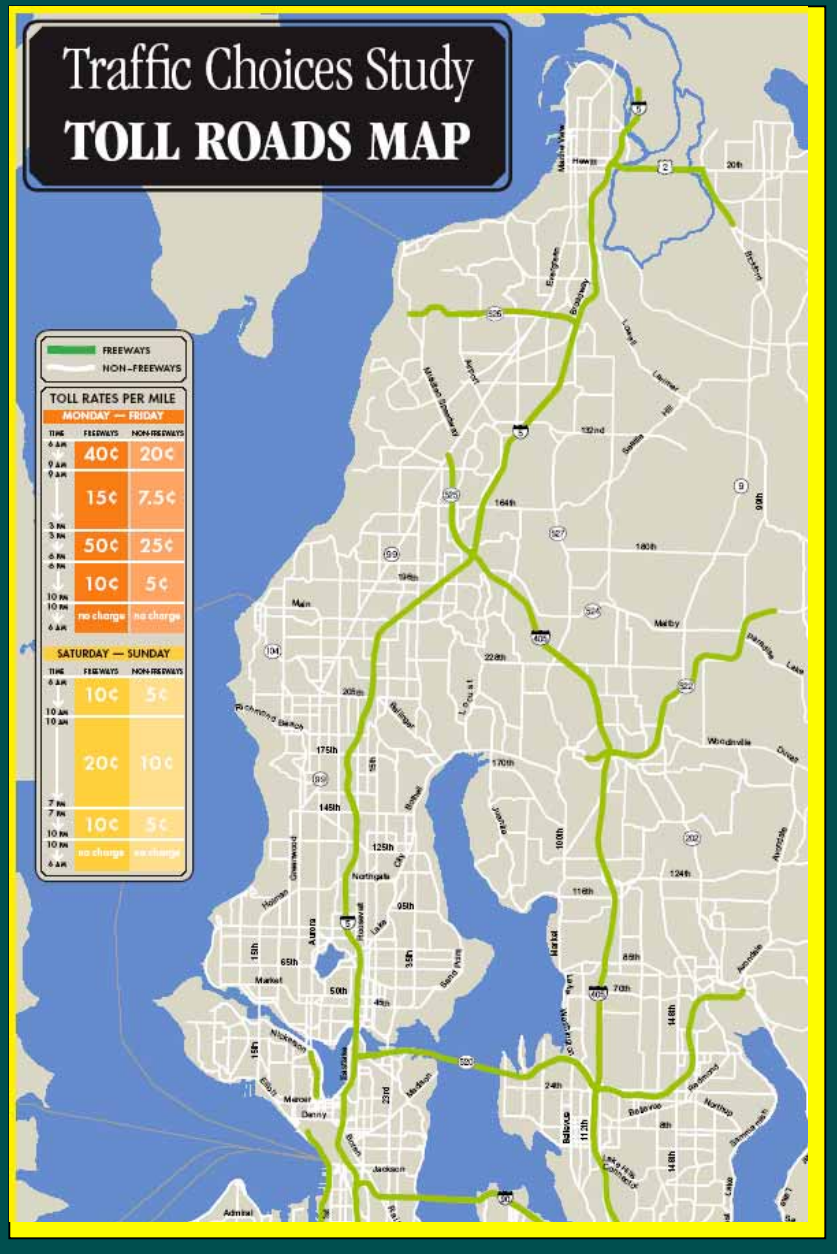
Based on theoretical "economic efficient" tolls

- Recognizing artificial tolling environment (no impact on ambient congestion)
- Imperfect match of toll rates with conditions is desirable, generating variability for statistical modeling

Research objectives require multi-dimensionality

- Ideal: Variation of tolls by time of day, day of week, location, facility type, direction
- Practical: Emphasizes some dimensions while collapsing others

Customer: Keep it simple, simple, simple



OPERATION – Functional Summary

- **450 OBU installations and removals**
- **System fully operational for over 18 months**
- **Over 270 participating households**
  - Up to 18 months of trip data per household
- **Hundreds of customer service calls**
- **Over 4,000 invoices distributed**
- **Over 100,000 device to central system transactions**
- **Over 700,000 individual trip records**
- **Household surveys and focus groups**

PRELIMINARY RESULTS - Descriptive Statistics

Descriptive Statistics, Expermintal Period*

Metric	AM PEAK	MID-DAY	PM PEAK	EVENING	NIGHT (Early AM)
Average Number of Trips per HH per period	1.02	2.73	1.77	0.81	0.24
VMT per HH per period	8.25	15.62	10.75	4.76	2.47
Vehicle-Hours per HH per period	0.47	1.06	0.95	0.26	0.07
Avg Speed (Miles/Hour)	17.6	14.7	11.3	18.1	34.0
Tolls Paid (Per Trip) (Experimental period)	$1.80	$0.47	$1.52	$0.30	$0.31

* Weekdays only

NOTE: All results are preliminary.

PRELIMINARY RESULTS - Elasticity of Demand

- During the AM peak travel period (6 - 9 AM)
  - Tolls could reduce household auto trips ~10%
  - Tolls could reduce vehicle miles traveled ~4%
- During the PM peak travel period (4 - 7 PM)
  - Tolls could reduce household auto trips ~6%
  - Tolls could reduce vehicle miles traveled ~11%

Estimated Elasticities* with Regard to Variable Costs of Auto Use

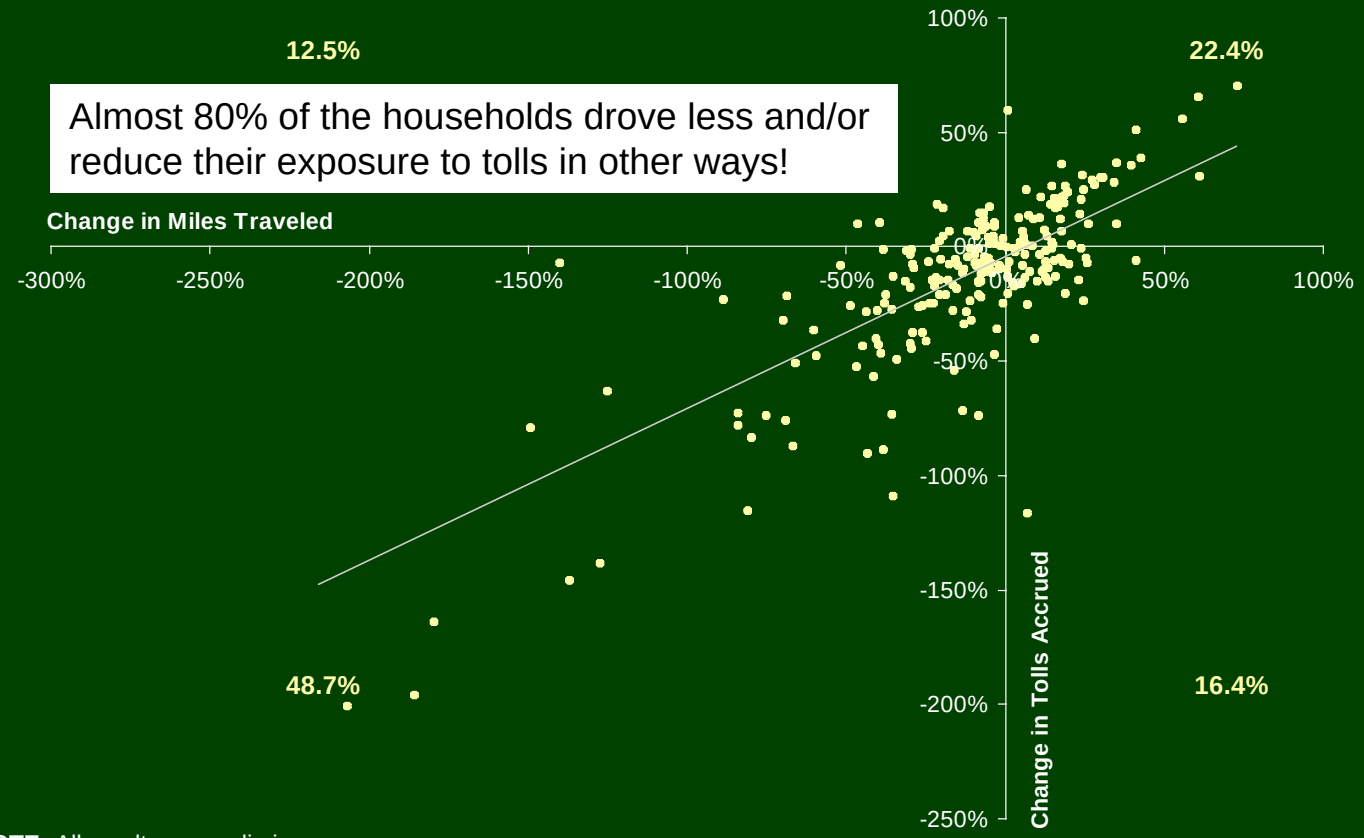
Metric	AM PEAK	MID-DAY	PM PEAK	EVENING	NIGHT (Early AM)
TRIPS	-0.1610	-0.1560	-0.0996	-0.1290	0.0532
VMT	-0.0531	0.1806	-0.1803	0.0491	0.3326
HOURS	-0.0019	0.2483	0.0795	0.0970	0.5346

* Weekdays only

NOTE: All results are preliminary.

PRELIMINARY RESULTS - Changes in vehicle use

Percent Change in Vehicle Average Weekday Mileage and Tolls Accrued
[Tolling Period Compared to Baseline Period]



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PRELIMINARY RESULTS - Survey

- Survey responses both substantiate the data results and provide evidence for a causal relationship. 70% of participants stated they changed their behavior in response to the tolls.
- Some attitudes toward charging also appear to have changed for participating households:

For this question we would like you to tell us (on a scale of 1 to 7) how strongly you agreed or disagreed with the following statements BEFORE you participated in the Traffic Choices study and how strongly you agree or disagree with these same statements NOW.

		Opinion BEFORE Traffic Choices study	Opinion NOW
In favor of trying new incentives, e.g. congestion charging	We should try new incentives and disincentives for travel on our roads to help improve traffic flow, as well as help pay for the roads and transit we need. This could include allowing people a choice to buy into a faster lane, or charging fees to travel on roads when they're the most clogged.	4.3	4.8
Pay-per use systems motivate changes in behavior	A pay-for-use type system, such as tolls or access fees to use a particular road, bridge, or highway creates incentives to carpool, use transit, combine trips, travel less often, or pick a different route.	4.5	5.0
Revenues should pay for road network improvements	A pay-for-use type system only makes sense if the amount each user pays reflects costs that user incurs and the funds collected go directly to pay for the road network on which they are charged.	4.8	5.2

PRELIMINARY RESULTS - Focus Groups

- Overall, participants reported they changed travel behavior over the course of the study.
- Changes in behavior were largely driven by costs, but some found additional benefits:
  - Savings in time
  - More comfortable or interesting drive
  - Time to read on the bus
- The availability of real-time tolls on the traffic meter heightened participants' awareness of the cost of travel.
- Participants think that revenues should be dedicated to maintaining and improving transportation systems.
- Privacy of travel data is a concern, but not to the extent that it would derail the use of this technology.

OUTLOOK - Expected Full Results

- **Understanding of driver behavior: price elasticity of demand (details by time of day, day of week, etc.)**
- **Substitutability of other routes, transit/ridesharing, etc.**
- **Differences by HH type (income, size, fleet, transit accessibility)**
- **Projection of revenues, congestion reduction and other system level consequences**
- **Examination of participant perceptions (e.g. technology and privacy)**
- **Additional systems design work:**
  - Data protection and privacy
  - Verification and enforcement systems
  - Ancillary geo-positioning capabilities (e.g. microgyro, DSRC, GSM)
  - Vehicle Infrastructure Integration (VII)

OUTLOOK - Estimating Revenue Potential

- **Difficult to do at this time, only sketch analysis results…**
- **Depends upon final equilibrium toll values…**
- **Project will develop a formal estimate over the next 6 months…**

Time, distance, place tolling proceeds (order of magnitude):
~$1.5-$2.5 billion per year

Region's share of State fuel tax proceeds:
~$500 million per year

- **Costs for a fuel tax collection system**
  - Initialization Costs = NA
  - Operations = 1% of proceeds
- **Costs for a distance tolling system, (based on the Netherlands' cost monitor)**
  - Initialization Costs = ~$0.75-$1.5 billion
  - Operations = 5-10% of proceeds

OUTLOOK – System Design and Policy

- Verification and Payment
  - Core technology for satellite-based toll systems is mature
  - Enforcement may require other facility use verification (DSRC, video capture, mobile enforcement).
  - Arterial tolling systems have unique design requirements
- Fairness
  - Direct use charging addresses existing horizontal inequalities
  - Road charging improves overall economic efficiency leaving society with greater resources available to address equity
- Privacy
  - Privacy questions involve what data leaves the vehicle, and what safeguards are in place to limit its availability and use.

OUTLOOK - Conclusion

- **Project demonstrates general feasibility of GPS-based solution for tolling applications in US**
- **Successful operational results may influence long-term planning and policy making in the Puget Sound region and elsewhere**
- **Important policy questions such as privacy and equity will be better understood**
- **Large-scale deployment of a GPS-based tolling solution depends on a viable business model and public acceptance of underlying concepts**

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http://www.psrc.org/projects/trafficchoices/index.htm